

WHAT IS CLAIMED IS:

- 1
- 2 1. A fluid delivery unit for an electrosurgical instrument, comprising:
3 a tube including a proximal portion and a distal portion, the proximal portion
4 being substantially linear, and the distal portion having a first arm, a second
5 arm, and a curved portion between the first arm and the second arm, the
6 second arm terminating proximally in a tube terminus, wherein the
7 tube terminus is closed, and wherein the proximal portion is adapted
8 for connection to a fluid source for supplying a fluid to the distal portion.
- 9
- 1 2. The fluid delivery unit of claim 1, wherein the first arm and the
2 second arm lie substantially parallel to each other.
- 3
- 1 3. The fluid delivery unit of claim 1, further comprising a return tube
2 tray affixed to the distal portion of the tube, the tray adapted for retaining the
3 fluid supplied to the distal portion of the tube.
- 4
- 1 4. The fluid delivery unit of claim 1, wherein the tube includes an
2 internal fluid delivery lumen for supplying the fluid to the distal portion of
3 the tube.
- 4
- 1 5. The fluid delivery unit of claim 1, wherein the distal portion of the
2 tube includes at least one fluid delivery port.
- 3
- 1 6. The fluid delivery unit of claim 5, wherein the at least one fluid
2 delivery port is directed towards the center of a void, the void located
3 between the first arm and the second arm.
- 4
- 1 7. The fluid delivery unit of claim 5, wherein the at least fluid delivery
2 port comprises a plurality of fluid delivery ports, and the plurality of fluid
3 delivery ports are dispersed radially on the distal portion of the tube.

1 8. The fluid delivery unit of claim 4, wherein the distal portion of the
2 tube includes a plurality of notches dispersed longitudinally on the distal
3 portion of the tube, each of the plurality of notches in communication with
4 the fluid delivery lumen, and each of the plurality of notches defining a fluid
5 delivery port.

6
1 9. The fluid delivery unit of claim 1, wherein the first arm and the
2 second arm are separated by a distance in the range of from about 1 mm to
3 20 mm.

4
1 10. The fluid delivery unit of claim 1, wherein the curved portion has a
2 u-shaped curve.

3
1 11. The fluid delivery unit of claim 1, wherein the distal portion of the
2 tube includes a bend at an angle in the range of from about 5° to 85° with
3 respect to the proximal portion.

4
1 12. The fluid delivery unit of claim 1, wherein the tube comprises an
2 electrically conducting material selected from the group consisting of
3 platinum, stainless steel, molybdenum, tungsten, titanium, molybdenum,
4 nickel, iridium, and their alloys.

5
1 13. The fluid delivery unit of claim 1, wherein the proximal portion of
2 the tube is at least partially encased within a shaft of the instrument, the shaft
3 comprising an electrically insulating material.

4
1 14. The fluid delivery unit of claim 13, wherein the distal portion of the
2 tube defines a void adjacent to a distal end of the shaft.

3
1 15. The fluid delivery unit of claim 14, wherein the tube terminus is
2 enclosed within the shaft.

1 16. The fluid delivery unit of claim 1, wherein the tube is electrically
2 coupled to a connection block of the instrument.

3
1 17. The fluid delivery unit of claim 1, wherein the distal portion of the
2 tube functions as a return electrode for the instrument.

3
1 18. The fluid delivery unit of claim 1, wherein the tube has an external
2 diameter in the range of from about 0.5 mm to 10 mm.

3
1 19. The fluid delivery unit of claim 1, wherein the tube has an internal
2 diameter in the range of from about 0.2 mm to 9 mm.

3
1 20. An electrosurgical probe, comprising:
2 a shaft having a shaft distal end and a shaft proximal end;
3 an electrode support articulated with respect to the shaft distal end;
4 an active electrode disposed on the electrode support; and
5 a return electrode extending distally from the shaft distal end,
6 wherein the return electrode is adapted as a conduit for transportation and
7 discharge of an electrically conductive fluid.

8
1 21. The probe of claim 20, wherein the return electrode comprises a
2 tube, the tube comprising an electrically conducting material.

3
1 22. The probe of claim 21, wherein the tube comprises a material
2 selected from the group consisting of platinum, stainless steel, molybdenum,
3 tungsten, titanium, molybdenum, nickel, iridium, and their alloys.

4
1 23. The probe of claim 20, wherein the return electrode is in the form of
2 a substantially u-shaped tube.

3
1 24. The probe of claim 20, wherein the return electrode has a plurality of
2 fluid delivery ports therein, each of the plurality of fluid delivery ports

adapted for discharging an electrically conductive fluid therefrom.

25. The probe of claim 20, wherein the tube includes a bend at an angle in the range of from about 5° to 85° with respect to the shaft.

26. The probe of claim 21, wherein the tube comprises a distal portion having an internal fluid delivery lumen, the distal portion including a first arm, a second arm, and a curved portion.

27. The probe of claim 26, further comprising an electrically insulating tray affixed to the distal portion of the tube.

28. The probe of claim 27, wherein the tray lies between the first arm and the second arm.

29. The probe of claim 28, wherein the tray is adapted for retaining at least a portion of the electrically conductive fluid discharged from the return electrode.

30. The probe of claim 26, wherein the distal portion of the tube includes a plurality of notches therein.

31. The probe of claim 29, wherein each of the plurality of notches is in communication with the fluid delivery lumen, and each of the plurality of notches defining a fluid delivery port.

32. The probe of claim 29, wherein the plurality of notches are jointly adapted for grasping tissue.

33. The probe of claim 27, wherein the tray is adapted for preventing contact between the return electrode and a patient's tissue.

1 34. The probe of claim 27, wherein the tray comprises a silicone rubber.

2
1 35. The probe of claim 27, wherein the tray includes a plurality of tray
2 support units adapted for coupling the tray to the tube.

3
1 36. The probe of claim 34, wherein the plurality of tray support units are
2 jointly adapted for grasping tissue.

3
1 37. The probe of claim 20, wherein the probe is adapted for being shifted
2 between a closed configuration and an open configuration, wherein in the
3 closed configuration the return electrode and the electrode support are
4 juxtaposed, and in the open configuration the return electrode and the
5 electrode support are parted from each other.

6
1 38. The probe of claim 37, wherein the closed configuration is adapted
2 for clamping, ablating, and coagulating tissue.

3
1 39. The probe of claim 37, wherein the open configuration is adapted for
2 releasing and severing tissue.

3
1 40. The probe of claim 37, wherein the return electrode is fixed and the
2 electrode support is pivotable.

4
1 41. The probe of claim 37, wherein in the closed configuration a gap
2 exists between the active electrode and the return electrode, and the gap is in
3 the range of from about 0.2 mm to about 10 mm.

4
1 42. The probe of claim 37, wherein in the closed configuration a gap
2 exists between the active electrode and the return electrode, and the gap is in
3 the range of from about 1 mm to about 3 mm.

2 43. The probe of claim 37, wherein the return electrode includes a first
3 arm and a second arm, and in the closed configuration the active electrode
4 lies between the first arm and the second arm.

5
1 44. The probe of claim 37, wherein the electrode support includes a
2 peripheral groove, the groove adapted for alignment with a surface of the
3 return electrode when the probe is in the closed configuration.

4
1 45. The probe of claim 37, wherein the return electrode defines a void
2 adjacent to the shaft distal end.

3
1 46. The probe of claim 45, wherein the electrode support includes a distal
2 nose portion, and wherein, in the closed configuration, a distal portion of the
3 active electrode extends through the void to a location inferior to the plane of
4 the return electrode.

5
1 47. The probe of claim 46, wherein the probe is adapted for operation in
2 an ablation mode in the closed configuration.

3
1 48. The probe of claim 20, wherein the active electrode is affixed to an
2 inferior surface of the electrode support.

3
1 49. The probe of claim 48, wherein the inferior surface includes an
2 angled portion.

3
1 50. The probe of claim 20, wherein the active electrode comprises a wire
2 or a blade.

3
1 51. The probe of claim 20, wherein the active electrode comprises a
2 material selected from the group consisting of platinum, stainless steel,
3 molybdenum, tungsten, titanium, molybdenum, nickel, iridium, and their
4 alloys.

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1 52. The probe of claim 20, wherein the return electrode comprises a first
2 arm, a second arm lying substantially parallel to the first arm, and a curved
3 portion between the first arm and the second arm.

4

1 53. The probe of claim 20, wherein the shaft comprises an electrically
2 insulating material, and the electrode support comprises a ceramic, a glass, a
3 polyimide, or a silicone rubber.

4

1 54. The probe of claim 20, further comprising an actuator unit for
2 shifting the probe between an open configuration and a closed configuration.

3

1 55. The probe of claim 54, further comprising a handle affixed to the
2 shaft proximal end, wherein the actuator unit is disposed on the handle.

3

1 56. The probe of claim 55, wherein the handle accommodates a
2 connection block, the connection block adapted for coupling the active
3 electrode and the return electrode to a high frequency power supply.

4

1 57. The probe of claim 56, further comprising a mode switch for
2 switching the power supply between a sub-ablation mode and an ablation
3 mode.

4

1 58. An electrosurgical probe, comprising:
2 a shaft having a shaft distal end and a shaft proximal end;
3 an electrode support articulated with respect to the shaft distal end,
4 wherein articulation of the electrode support shifts the probe between an
5 open configuration and a closed configuration;
6 an active electrode disposed on the electrode support; and
7 a return electrode extending distally from the shaft distal end,
8 wherein the return electrode includes a first arm and a second arm, and the
9 active electrode lies between the first arm and the second arm when the

10 probe is in the closed configuration.

11
1 59. The probe of claim 58, wherein the return electrode comprises a
2 metal tube, and the probe further comprises a tray affixed to the metal tube:
3

1 60. The probe of claim 59, wherein the active electrode is disposed on an
2 inferior surface of the electrode support, and wherein in the closed
3 configuration the tray lies substantially parallel to the electrode support to
4 define an electrode chamber, and the active electrode lies within the
5 electrode chamber.

6
1 61. The probe of claim 58, wherein the return electrode is adapted as a
2 conduit for transportation and discharge of an electrically conductive fluid.
3

1 62. An electrosurgical probe, comprising:
2 a shaft having a shaft distal end and a shaft proximal end;
3 an electrode support disposed at the shaft distal end;
4 an active electrode disposed on the electrode support;
5 a return electrode disposed at the shaft distal end; and
6 an electrically insulating tray affixed to the return electrode, wherein
7 the tray at least partially encloses a distal portion of the return electrode.
8

1 63. The probe of claim 62, wherein the return electrode comprises a first
2 arm and a second arm, the tray includes a tray base, and the tray base fills a
3 void between the first arm and the second arm.

4
1 64. The probe of claim 62, wherein the tray comprises a silicone rubber.
2

1 65. The probe of claim 62, wherein the tray includes a tray cap, the tray
2 cap at least partially enclosing a distal end of the return electrode.
3
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1 66. The probe of claim 62, wherein the tray prevents inadvertent contact
2 between a patient's tissue and the return electrode.

3
1 67. The probe of claim 62, wherein the return electrode comprises a
2 metal tube adapted for delivery of an electrically conductive fluid therefrom.

3
1 68. The probe of claim 62, wherein the electrode support is articulated
2 with respect to the shaft distal end, wherein articulation of the electrode
3 support shifts the probe between an open configuration and a closed
4 configuration.

5
1 69. The probe of claim 68, wherein in the closed configuration the
2 electrode support and the tray jointly define an electrode chamber.

3
1 70. An electrosurgical system, comprising:
2 a shaft having a shaft distal end and a shaft proximal end;
3 an electrode assembly affixed to the shaft distal end, the electrode
4 assembly capable of adopting an open configuration or a closed
5 configuration, wherein the electrode assembly includes an electrode support
6 disposed distal to the shaft distal end, an active electrode disposed on the
7 electrode support, and a return electrode affixed to the shaft distal end at a
8 position subjacent to the electrode support, wherein the return electrode
9 comprises a tube adapted for delivering an electrically conductive fluid to the
10 electrode assembly; and
11 a power supply having first and second opposite poles, the active
12 electrode and the return electrode coupled to the first and second opposite
13 poles, and the power supply adapted for applying a high frequency voltage
14 between the active electrode and the return electrode.

1 71. The system of claim 70, wherein the tube comprises a first arm and a
2 second arm, and the system further comprises a tray affixed to the tube,
3 wherein the tray is adapted for preventing tissue from passing between the
4 first arm and the second arm.

5
1 72. The system of claim 70, wherein the tray comprises an electrically
2 insulating material.

3
1 73. The system of claim 70, wherein the electrically conductive fluid
2 provides a current flow path between the active electrode and the return
3 electrode.

4
1 74. The system of claim 70, further comprising an actuator unit in
2 communication with the electrode support, the actuator unit adapted for
3 shifting the electrode assembly between the open configuration and the
4 closed configuration.

5
1 75. The system of claim 74, wherein the electrode support is moveable
2 with respect to the return electrode, and actuation of the actuator unit moves
3 the electrode support such that the electrode assembly adopts the open
4 configuration or the closed configuration.

5
1 76. The system of claim 74, further comprising a mode switch for
2 switching the system between a sub-ablation mode and an ablation mode.

3
1 77. The system of claim 76, wherein the mode switch is responsive to a
2 change in configuration of the electrode assembly, or is responsive to
3 actuation of the actuator unit.

4
1 78. The system of claim 70, wherein the closed configuration is adapted
2 for clamping, ablating, or coagulating a target tissue, and the open
3 configuration is adapted for releasing and severing a target tissue.

4
1 79. The system of claim 76, wherein in the sub-ablation mode the active
2 electrode is adapted for coagulating a target tissue, and in the ablation mode
3 the active electrode is adapted for volumetrically removing the target tissue.
4 via localized molecular dissociation of target tissue components.

5
1 80. An electrosurgical probe, comprising:
2 a shaft having a shaft distal end and a shaft proximal end;
3 an electrode support articulated to the shaft distal end;
4 an active electrode arranged on an inferior surface of the electrode
5 support; and
6 a return electrode affixed to the shaft distal end, the return electrode
7 opposing the electrode support.

8
1 81. The probe of claim 80, wherein the return electrode comprises a fluid
2 delivery unit adapted for delivering an electrically conductive fluid between
3 the return electrode and the active electrode such that the electrically
4 conductive fluid provides a current flow path between the active electrode
5 and the return electrode.

6
1 82. The probe of claim 80, further comprising an articulation unit for
2 articulating the electrode support with respect to the shaft distal end.

3
1 83. The probe of claim 82, wherein the articulation unit comprises a
2 joining unit and a pivot unit, the joining unit coupled between the electrode
3 support and the pivot unit, and the pivot unit housed within the shaft distal
4 end.

5
1 84. The probe of claim 83, wherein the pivot unit comprises a pin
2 rotatable within a housing of the shaft distal end.

1 85. The probe of claim 80, wherein the electrode support is adapted for
2 movement between a closed configuration and an open configuration,
3 wherein in the closed configuration the electrode support is juxtaposed with
4 the return electrode, and in the open configuration the electrode support is
5 withdrawn from the return electrode.

6
1 86. The probe of claim 85, further comprising an actuator unit for
2 shifting the electrode support between the closed configuration and the open
3 configuration.

4
1 87. The probe of claim 80, further comprising an electrically insulating
2 tray affixed to the return electrode.

3
1 88. The probe of claim 87, wherein the tray is adapted for retaining
2 electrically conductive fluid and for promoting generation of a plasma in the
3 vicinity of the active electrode.

4
1 89. The probe of claim 85, wherein the return electrode comprises a first
2 arm and a second arm, and wherein in the closed configuration the active
3 electrode is arranged substantially parallel to the first and second arms of the
4 return electrode.

5
1 90. The probe of claim 89, wherein each of the first arm and the second
2 arm includes a plurality of notches therein.

3
1 91. The probe of claim 90, wherein each of the plurality of notches
2 defines a fluid delivery port.

3
1 92. The probe of claim 80, wherein the return electrode includes a bend
2 at an angle in the range of from about 5° to 85° with respect to the shaft.

1 93. The probe of claim 80, wherein the active electrode comprises a
2 substantially linear wire or blade.

1 94. The probe of claim 80, wherein the active electrode is disposed on an
2 inferior surface of the electrode support.

1 95. A method for treating a target tissue *in situ*, comprising:

2 a) providing an electrosurgical apparatus, the apparatus including a
3 shaft having a shaft distal end, an electrode assembly disposed at the shaft
4 distal end, the electrode assembly including an active electrode and a return
5 electrode, the return electrode comprising an exposed distal portion of an
6 electrically conducting tube, the tube comprising a proximal portion encased
7 within the shaft, and the distal portion protruding distally from the shaft
8 distal end, wherein the return electrode comprises a tube adapted for
9 delivering an electrically conductive fluid between the return electrode and
10 the active electrode;

11 b) positioning the active electrode in at least close proximity to the
12 target tissue; and

13 c) applying a high frequency voltage between the active electrode and
14 the return electrode.

15 96. The method of claim 95, further comprising:

1 d) discharging an electrically conductive fluid from the distal portion
2 of the tube towards the active electrode.

1 97. The method of claim 96, wherein said step d) provides a current flow
2 path between the active electrode and the return electrode.

1 98. The method of claim 96, wherein the electrosurgical apparatus further
2 includes a tray affixed to the distal portion of the tube, wherein the tray is
3 adapted for retaining a portion of the electrically conductive fluid discharged
4 in said step d).

5

1 99. The method of claim 96, wherein the distal portion of the tube
2 includes a plurality of fluid delivery ports, and wherein said step d)
3 comprises discharging the electrically conductive fluid from each of the
4 plurality of fluid delivery ports.

5

1 100. A method of modifying a target tissue of a patient, the method
2 comprising:

3 a) providing an electrosurgical system including a probe and a high
4 frequency power supply, and the probe including a shaft distal end bearing
5 an electrode assembly, the electrode assembly including an articulated
6 electrode support, an active electrode disposed on an inferior surface of the
7 electrode support, and a return electrode,;

8 b) clamping the target tissue within the electrode assembly; and

9 c) coagulating the target tissue by application of a first high frequency
10 voltage from the power supply between the active electrode and the return
11 electrode.

12

1 101. The method of claim 100, further comprising:

2 d) severing the target tissue by application of a second high frequency
3 voltage from the power supply between the active electrode and the return
4 electrode.

5

1 102. The method of claim 100, further comprising:

2 e) delivering an electrically conductive fluid to the electrode assembly
3 from at least one fluid delivery port within the return electrode.

4

1 103. The method of claim 101, further comprising:

2 f) prior to said step d), unclamping the target tissue.
3

1 104. The method of claim 100, wherein the probe can adopt an open
2 configuration or a closed configuration by articulation of the electrode
3 support.

4
1 105. The method of claim 100, wherein the electrosurgical system further
2 includes an actuator unit for shifting the probe between an open
3 configuration and a closed configuration, and wherein said step b)
4 comprises:

5 g) via the actuator unit, moving the electrode support to configure the
6 probe in the open configuration;

7 h) positioning the probe such that the target tissue is positioned
8 between the active electrode and the return electrode; and

9 i) via the actuator unit, moving the electrode support to configure the
10 probe in the closed configuration, wherein the target tissue is clamped
11 between the active electrode and the return electrode.

12
1 106. The method of claim 100, wherein the probe further includes a tray
2 suspended between a first arm and a second arm of the return electrode, and
3 wherein the tray supports the target tissue during said step b).

4
1 107. The method of claim 106, wherein the tray comprises an electrically
2 insulating material, and wherein the tray prevents contact between the return
3 electrode and a non-target tissue of the patient.

4
1 108. The method of claim 106, wherein the tray includes a plurality of tray
2 support units, and wherein the plurality of tray support units promote
3 grasping of the target tissue by the electrode assembly during said step b).

4
1 109. The method of claim 105, wherein the actuator unit is directly
2 coupled to a mode switch for switching the power supply between a sub-
3 ablation mode and an ablation mode.

1 110. A method for electrosurgically treating a target tissue of a patient,
2 comprising:

3 a) providing an electrosurgical apparatus, the apparatus including a
4 shaft having a shaft distal end, an electrode assembly disposed at the shaft
5 distal end, the electrode assembly including an articulated electrode support,
6 an active electrode disposed on the electrode support, and a return electrode
7 affixed to the shaft distal end, the electrode assembly adapted for being
8 shifted between a closed configuration and an open configuration;

9 b) positioning the active electrode in at least close proximity to the
10 target tissue; and

11 c) applying a high frequency voltage between the active electrode and
12 the return electrode, wherein the voltage is sufficient to ablate or modify at
13 least a portion of the target tissue.

14
1 111. The method of claim 110, further comprising:

2 d) delivering an electrically conductive fluid to at least a portion of
3 the electrode assembly or to the target tissue, wherein the return electrode
4 comprises an electrically conducting tube adapted for delivering and
5 discharging the electrically conductive fluid, and the electrically conductive
6 fluid is delivered via the return electrode.

7
1 112. The method of claim 110, wherein the return electrode includes at
2 least one fluid delivery port, and the electrically conductive fluid is
3 discharged from the return electrode via the at least one fluid delivery port
4 towards the active electrode.

5
1 113. A return electrode for an electrosurgical apparatus, the return
2 electrode comprising: an electrically conducting tube having a distal portion
3 and a proximal portion, the distal portion having at least one fluid delivery
4 port, and the tube adapted as a conduit for an electrically conductive fluid.

1 114. The return electrode of claim 113, wherein the proximal portion of
2 the tube is adapted for coupling to a fluid supply unit.

1 115. The return electrode of claim 113, further comprising a return
2 electrode lead coupled to the proximal portion of the tube.

1 116. The return electrode of claim 113, wherein the distal portion of the
2 tube includes a curved portion.

1 117. The return electrode of claim 113, wherein the distal portion of the
2 tube is substantially u-shaped.

1 118. The return electrode of claim 113, wherein the distal portion of the
2 tube is partially enclosed by an electrically insulating tray.

1 119. The return electrode of claim 118, wherein the tray comprises a
2 silicone rubber.

1 120. The return electrode of claim 113, wherein the tube comprises a
2 material selected from the group consisting of platinum, stainless steel,
3 molybdenum, tungsten, titanium, molybdenum, nickel, iridium, and their
4 alloys.